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ABSTRACT

In order to assess faculty and student use of, and attitudes toward, instructional computing at Dartmouth College, faculty members and students were surveyed during the spring of 1981 to determine how computing was being used in Dartmouth courses. Each of the 450 faculty members who taught an on-campus course from summer 1980 through spring 1981 was sent to four-question card asking about his or her use of computing. Follow-up telephone interviews with 108 faculty members indicated that computing was used in a total of 206 different courses. To determine student attitudes and patterns of computer use, questionnaires were sent to a stratified, random sample of 516 students, 416 of whom responded. Results of the faculty survey indicated a slight increase in instructional computing since 1975. Computing was found to be integral to 42 percent and supplemental to 47 percent of the courses taught by surveyed faculty. The student survey indicated that 93 percent of the students had used a computer while at Dartmouth. Students generally had a positive attitude toward computing. Male and female students did not differ in computer use, but students majoring in the sciences used computers more heavily than students in other disciplines. Eight data tables and two figures accompany the text. (JL)

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Computing in College Courses: The Dartmouth Experience

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Computing in College Courses:

The Dartmouth Experience

This paper reports the results of a project assessing faculty and student use of and attitudes toward instructional computing at Dartmouth College. Since 1964 the Dartmouth community has had the use of a time-sharing computer system, which has matured and become an integral part of the educational environment. What differentiates computing at Dartmouth from that at other educational institutions is the accessibility to computing resources at the College. Fssentially, Dartmouth applies a "library model" to computing by granting free and open access to all members of the academic community. The advantages and cost-effectiveness of using such a model have been addressed previously (Luehrmann and Nevison, 1974). Given the established tradition of a free-access policy to the time-sharing system, it is now important to determine the role of the computer in Dartmouth's instructional environment.

A previous survey of the faculty on instructional computing at Dartmouth was conducted in 1975. The findings of that survey are presented in earlier reports (Nevison, 1976a; 1976b) and, where appropriate, will be compared to findings from the present study. The present study, though, was the first time a representative sample of student attitudes and patterns of use at Dartmouth had been studied in any detail.

Method

During the Spring term of 1981, members of the faculty and students were surveyed to determine how computing was used in courses at Dartmouth. Each faculty member who taught an on-campus course from summer 1980 through spring 1981 was sent a four-question card asking about their use of computing. Of the faculty members queried, 323 out of 450 (72%) returned this initial card. Of these, 110 faculty members indicated that they had used computing in at least one course during the past academic year. Subsequently, we conducted telephone interviews with 108 of the 110 faculty members. These 108 instructors had used computing in a total of 206 different courses. To determine student attitudes and patterns of computer use, we sent a questionnaire to a random sample of Dartmouth students (both on and off campus), stratified by class and sex. Of the students queried, 416 out of 516 (81%) returned completed questionnaires.

Results and Discussion

Faculty Survey Findings

The results from the preliminary four-question card are shown in Table 1. These results demonstrate a slight, but consistent increase in the use of computing by faculty members at Dartmouth since 1975. While the use of computing in courses has remained relatively stable, more faculty members are using computing in their own research. The number of faculty members who have written a computer program also has increased over this time period. Currently, about one-quarter of the Dartmouth faculty use the computer for word processing. Overall, 72% of the faculty respondents use computing for one purpose or another.

Insert Table 1 About Here

We focused more closely on members of the faculty who used computing in their courses. We interviewed 13 instructors (teaching 17 courses) in the Humanities Division; 27 instructors (teaching 60 courses) in the Social Sciences Division; 55 instructors (teaching 106 courses) in the Sciences Division; and 13 instructors (teaching 23 courses) in the Tuck Business School. Telephone interviews took approximately 20 minutes and were conducted by student assistants at the Computer Center. We asked instructors various questions about their use of the computer in

courses and about their attitudes toward computing in general.

Use of Computing in Courses. Computing is used in a variety of ways in courses at Dartmouth, and the kind of use varies with division (Table 2). In humanities courses, for example, computing is used primarily for "drill and practice," where the computer evaluates student performance and diagnoses weaknesses. Instructors of courses in the social sciences use "canned" programs and also have students use the computer to manipulate data and explore relationships among variables in models. In science courses, instructors often require students to write computer programs as well as use existing programs. Instructors of business courses rely heavily on the use of existing programs.

Insert Table 2 About Here

Of the different uses of computing in courses, having students write their own programs demands the greatest degree of computer literacy. While none of the humanities courses requires students to write their own computer programs, two-thirds of the science and business courses and one-third of the social science courses that use computing require programming on the part of students (Table 3).

Insert Table 3 About Here

We asked instructors to characterize the role of computing in the structure of their course and what effect they felt computing had on the overall quality of the course. These results are presented in Figures 1 and 2. Overall, computing was perceived as "integral" in 42% of the courses, as "supplemental" in 47% of the courses, and as only "incidental" in 11% of the courses. The only real difference we found here among divisions was that computing was characterized as integral in only 24% of the humanities courses, while in science, social science, and business courses, computing was considered integral in about 50% of the courses. We also asked instructors to assess the effect of computing in their course. As shown in Figure 2, in no course did instructors report computing had a negative effect and in only a small percentage of courses was computing perceived to have no effect at all. In a clear majority of courses, computing was thought to make the course "better." Again, humanities instructors felt less strongly about the effect of computing than did instructors in the other divisions.

Insert Figures 1 and 2 About Here

Another way of looking at the role of computing is to examine the percentage of students' course time spent on computing. We asked instructors what percentage of assignments or course work required some sort of computing. Our results

showed that computing does not seem to take up much of student course time. In about two-thirds of the courses that used computing, less than 35% of the course work required students to use computing. Computing occupies an especially small part of instruction in humanities courses; in almost half of these courses, less than 10% of student course work required computing.

We also were interested in the computer-related resources that instructors used in courses. Table 4 presents the percentage of courses, categorized by division, using various resources in 1981. Table 4 also reports the overall percentages found in the 1975 survey, and here we can see what are perhaps some interesting trends. In 1981, for example, more courses used the computer for classroom demonstrations and, also, more courses used micro- and minicomputers than was the case in 1975. On the other hand, fewer classes made use of "special" terminals (e.g., Tektronix or Terak terminals) and computer center publications in 1981 than was the case in 1975.

Insert Table 4 About Here

Attitudes toward computing. We asked instructors questions concerning their attitudes toward computing as part of a course. More specifically, we were interested in how instructors felt computing affected the following:

- students' understanding of subject matter
- students' attitudes toward subject matter
- faculty interaction with students
- the way students work together
- faculty duties and responsibilities
- the quality of undergraduate liberal education.

We asked instructors to rate how computing affected these aspects of the course on a scale ranging from "very positively" to "very negatively", with an option for a "don't know" response. The percentages of instructors responding positively and negatively to the above questions are shown in Figure 3. As might be expected, the attitudes toward computing for this group of instructors were, in general, quite positive. In particular, instructors using computing in the classroom responded especially favorably regarding how computing affected students' understanding of the subject matter and how computing affected the quality of an undergraduate liberal education.

Insert Figure 3 About Here

Student Survey Findings

The student sample consisted of on- and off-campus students during the Spring 1981 term. Demographic characteristics of the student sample are presented in Table 5. The percentages shown in the table represent quite accurately characteristics of the student body as a whole.

Insert Table 5 About Here

Overall results. Compared to their counterparts at other colleges and universities, Dartmouth students are quite sophisticated in their use of computing. Our survey found that 53% of the students used a computer before matriculating at Dartmouth and 93% of the students have used the computer since coming to Dartmouth. Indeed, 86% of the freshman class used the computer during their first year at Dartmouth. This can be attributed largely to enrollment in introductory mathematics courses that require the use of computing.

According to our findings, 83% of all students at Dartmouth have written a computer program. Although this, too, is due mainly to enrollment in mathematics courses that require students to program, about one-quarter of the students have written a computer program for their personal use. Overall, 89% of the

students have used existing programs and 26% have used the computer as a word processor. Clearly, the high percentage of students using the computer cannot be attributed to students simply signing on to the computer and playing games.

Although there is a high level of computer use at Dartmouth, most students (69%) considered themselves "beginners" at using the computer. Overall, only 7% of the students described themselves as being "advanced" at using the computer.

As part of the survey, we asked students to rate the importance of some factors in determining the effectiveness of their use of the computer. These results are summarized in Table 6. The availability of terminals and help from computer center personnel are factors that students deem most important for effectively using the computer. Help from other students and fast computer response time are seen as somewhat important, and graphics terminals and software packages are seen as relatively unimportant factors.

Insert Table 6 About Here

In general, students had positive attitudes toward computing. They felt that computing improved their understanding of and attitudes toward the subject matter. They also felt that computing improved the quality of their undergraduate education.

They did not feel that computing affected--either positively or negatively--their interactions with instructors who used it in courses. The results concerning student attitudes are displayed graphically in Figure 4.

Insert Figure 4 About Here

In addition to the overall findings, we were interested in examining results of the survey broken down by two student demographic variables. The following sections report findings of the student survey categorized by sex of student and division of student major.

Sex of student. Males and females did not differ markedly on prior computer use, nor did they differ on overall use of the computer since matriculating at Dartmouth. About half of both males and females used a computer before attending Dartmouth and over 90% used the computer since coming to school. Attitudes toward computing also were similar for males and females. There was a difference, however, between self-reported level of computer skill between males and females. Female students were less confident than male students in their ability to deal with the computer. Over 80% of the females in our sample considered themselves beginners at using the computer; 64% of the males did so. Very few students (females: 3%, males: 9%) considered themselves computer experts.

There are some differences between males and females when we look at types of computer use. Table 7 displays male and female computer use--for a course and for personal use--of various activities: writing a computer program, using an existing program, and using the computer as a word processor. The Table shows that male and female computer use differs little when the activity is performed for a course. Males are more likely than females to use the computer for personal purposes, however, whether the activity is writing a computer program, using an existing program, or writing a paper.

Insert Table 7 About Here

Division of student major. Of the students majoring in sciences, 60% had used a computer before entering Dartmouth and almost all (98%) have used the computer since coming to Dartmouth. These percentages are slightly higher than those for social science majors (52%; 94%) and humanities majors (44%; 89%). There was no difference among student majors on attitudes toward computing. Level of self-reported computing skill did vary by division of student major. While half of the science majors categorized themselves as either intermediate or advanced users, only about one-quarter of the humanities and social science majors considered themselves in these categories.

Table 8 shows type of computer use categorized by division of student major. What is clear from the table is that students with science majors are more apt to use the computer for various activities than either students with humanities or social science majors. This is especially true for computer programming, where almost all science majors can be considered computer literate, and over one-third of them have written a program for personal use.

Insert Table 8 About Here

Clearly, the computer is used more heavily, and in a more sophisticated fashion, by students majoring in sciences. This in itself is not terribly surprising. What perhaps is more interesting is the level of computer use by students with other than science majors. Computing here is not seen as just being in the realm of the scientists.

Summary

At Dartmouth, all members of the academic community have free access to the use of computing and the frequency of use varies widely, particularly among courses and among students within a given course. While there have not been dramatic changes in the use of computing over the last six years, both

faculty and students are seeing greater applications for instructional computing. We have at Dartmouth a very literate computing community; about half the faculty and over 80% of the students have written at least one computer program. With the advent of new technologies (both in the realm of hardware and software), the functions of and uses of computers are likely to change in the coming decade. Considering predictions that an increasing percentage of the labor force will need to know something about computers, Dartmouth's implementation of instructional computing within a free-access environment seems to provide a useful model for other colleges and universities.

References

Luehrmann, A. W., & Nevison, J. M. Computer use under a free-access policy. Science, 1974, 184, 957-961.

Nevison, J. M. Computing as a matter of course: The instructional use of computers at Dartmouth College. Hanover, NH: Kiewit Computation Center, Dartmouth College, 1976. (a)

Nevison, J. M. Computing in the liberal arts college. Science, 1976, 194, 396-402. (b)

TABLE 1

Percentage of Responding Faculty Members
Using the Computer: 1975 and 1981

	1975	1981
Used computing in a course	29%	34%
Used computing in research	43%	56%
Have written a computer program	45%	56%
Used computing for word processing	*	24%

*not asked in 1975 survey

Number of faculty members returning card:

1975 = 332

1981 = 323

TABLE 2

Primary Use of Computing in Courses
by Academic Division
(Percentage of Courses)

Use of Computing	Humanities	Social Sciences	Sciences	Business
Students write programs	0%	7%	28%	17%
Use of "canned" programs	17%	28%	33%	65%
Drill and practice	65%	0%	0%	0%
Assignments/projects	12%	2%	11%	9%
Manipulate data	6%	35%	15%	0%
Class demonstrations	0%	15%	11%	9%
Administrative (e.g., grading, bookkeeping)	0%	13%	2%	0%

Number of courses: Humanities = 17
Social Sciences = 60
Sciences = 106
Business = 23

TABLE 3

Percentage of Courses that use Computing in Which Students Write Programs and Run Existing Programs by Academic Division

	Humanities	Social Sciences	Sciences	Business
Students write programs	0%	33%	66%	65%
Students run Existing Programs	94%	85%	83%	100%

TABLE 4

Percentage of Courses using Computer-Related Resources

Resource	Humanities	Social Sciences	Sciences	Business School	Overall	Overall
	1981	1981	1981	1981	1981	1975
Class demonstrations	12%	52%	44%	61%	45%	23%
Main Computer	94%	98%	96%	100%	97%	96%
Micro/minicomputers	12%	11%	16%	4%	13%	6%
Prime Computer	0%	6%	5%	0%	4%	*
Special terminals	24%	32%	37%	17%	32%	50%
Computer Center Publications	6%	28%	22%	17%	22%	35%

*not applicable for 1975 survey

TABLE 5

Demographic Characteristics of Student Sample

Sex:	
Male	67%
Female	33%
Class:	
1981	22%
1982	26%
1983	23%
1984	29%
Major Division:	
Humanities	26%
Social Science	38%
Science	29%
Other	2%
Undeclared	5%

TABLE 6

Student Rating of Factors Determining Effective Use of the Computer

Factor	Very Important	Somewhat Important	Not Important
Availability of terminals	72%	20%	7%
Fast response time	28%	58%	15%
Help from Computer Center Personnel	50%	40%	10%
Help from other students	38%	53%	9%
Use of graphics terminals	14%	43%	43%
Software packages	10%	27%	63%

TABLE 7

Male and Female Computer Use

Type of Computer Use	Male (N=278)	Female (N=138)
Wrote computer program*	86%	76%
...for a course*	78%	70%
...for personal use***	30%	13%
Used existing program*	92%	84%
...for a course	58%	54%
...for personal use*	64%	50%
Used computer as word processor	29%	20%
...for a course	15%	9%
...for personal use*	17%	8%

*differences between percentages statistically significant, p< .05
**differences between percentages statistically significant, p< .01
***differences between percentages statistically significant, p< .001

TABLE 8

Computer Use Categorized by
Division of Student Major

Type of Computer Use	Humanities (N=107)	Social Sciences (N=159)	Sciences (N=123)
Wrote computer program***	75%	77%	97%
...for a course***	61%	71%	94%
...for personal use***	18%	21%	38%
Used existing program	90%	89%	93%
...for a course***	45%	51%	76%
...for personal use	64%	61%	59%
Used computer as word processor	28%	23%	28%
...for a course	16%	11%	18%
...for personal use	13%	14%	16%

***differences between percentages statistically significant, $p < .001$

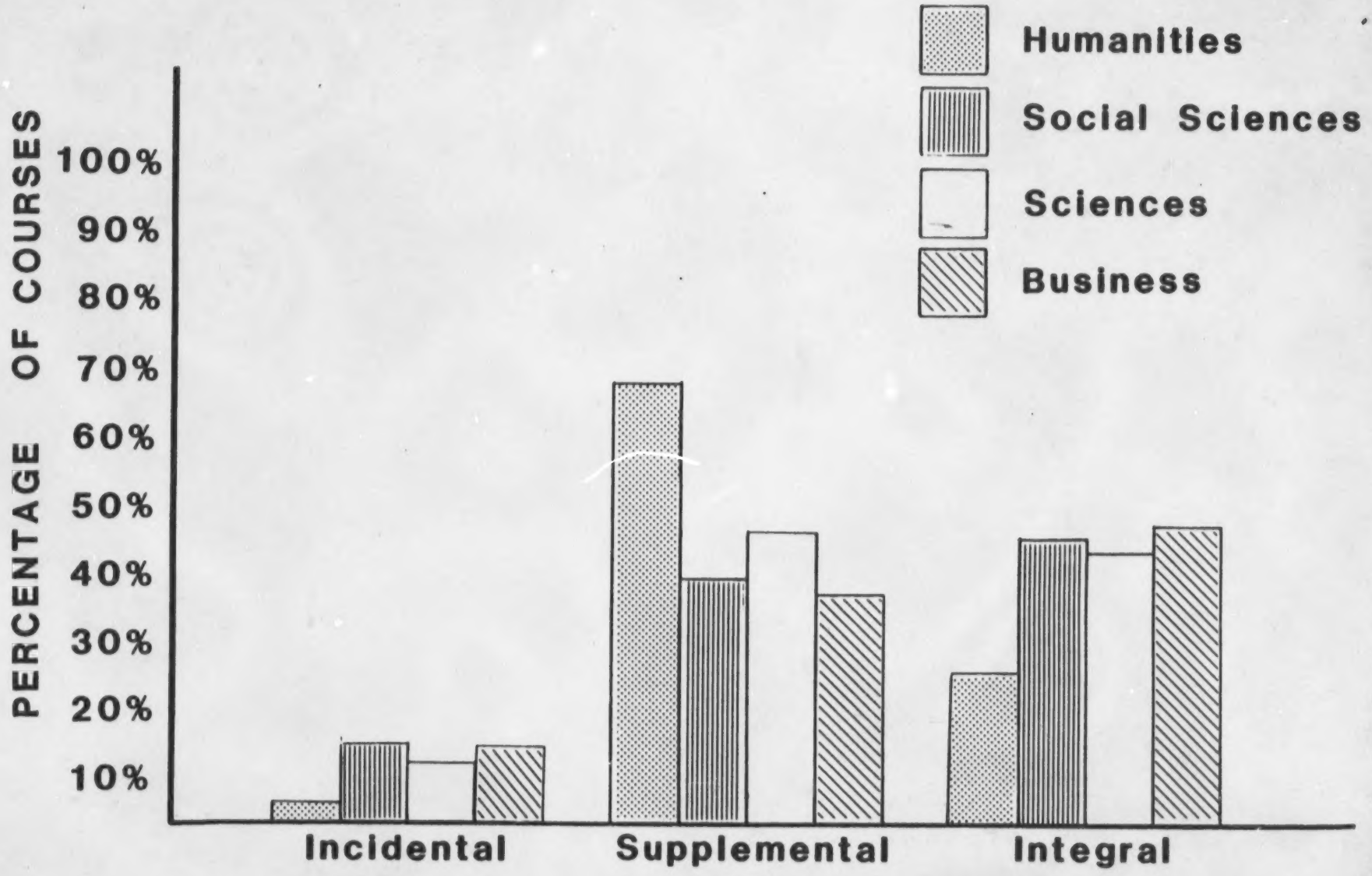

Figure 1. Role of Computing in Course

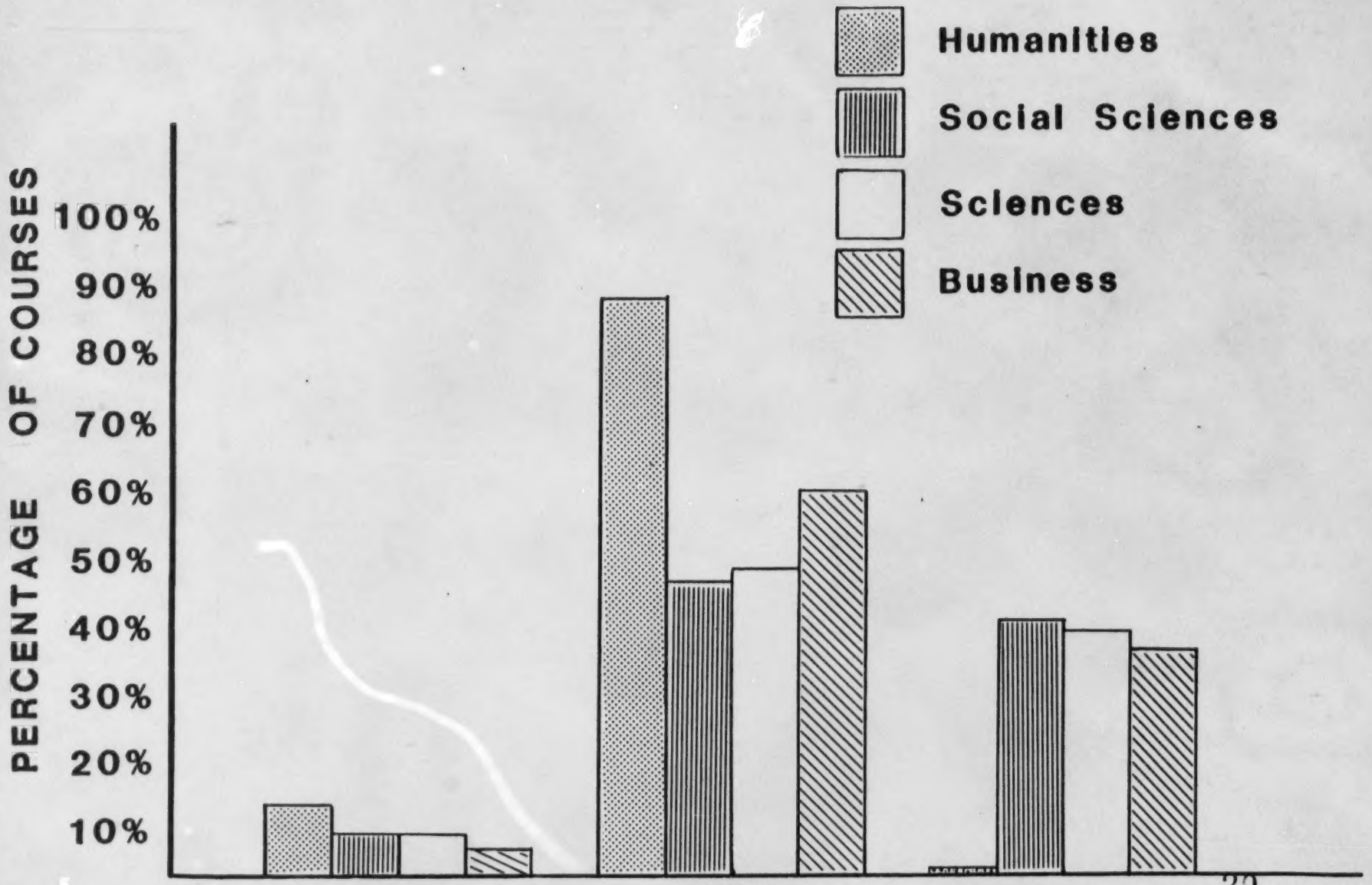

Figure 2. Effect of Computing on Quality of Course

Figure 3.
Faculty Attitudes Toward Computing

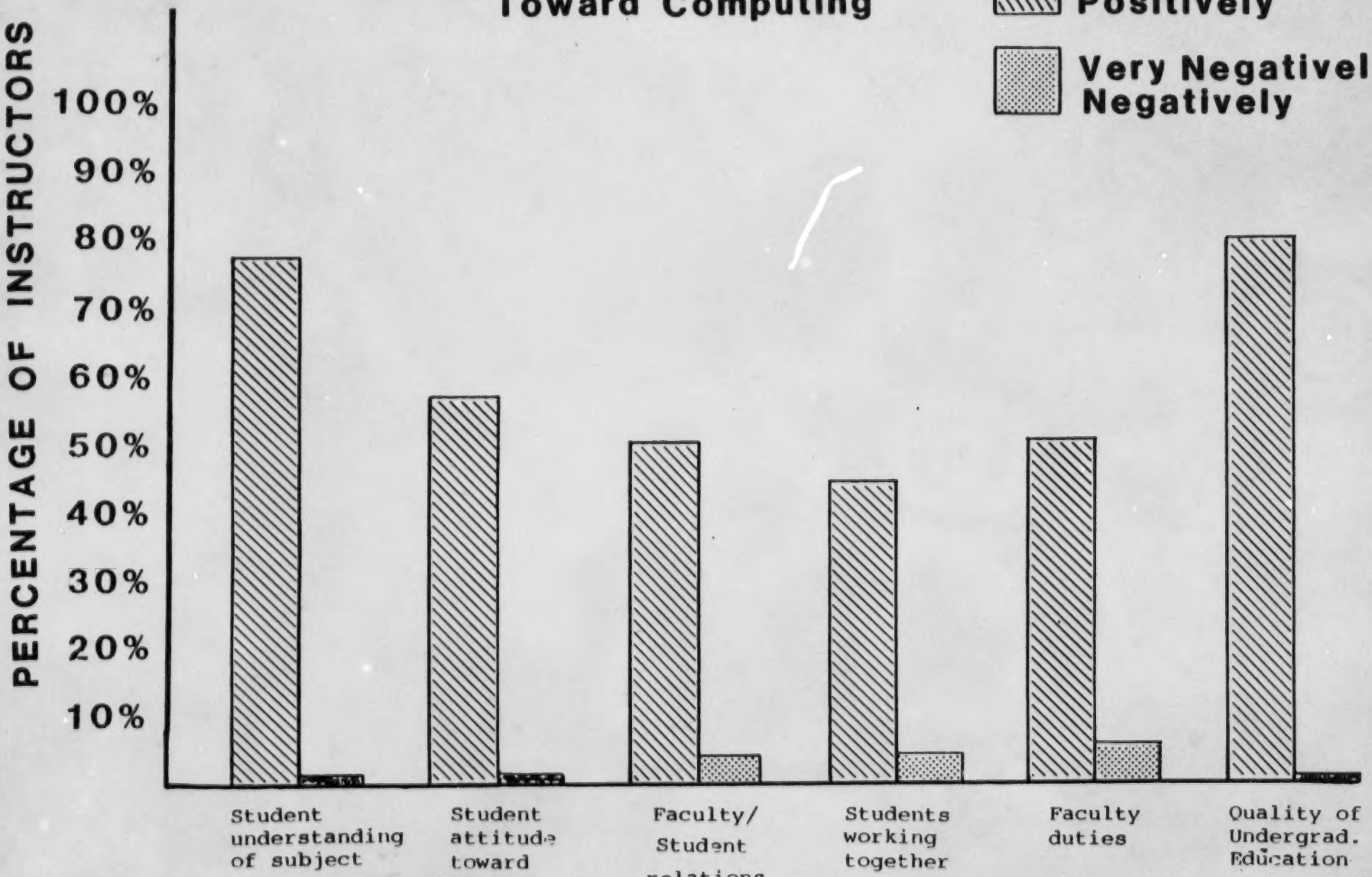

Figure 4.

Student attitudes toward Computing